Search for Low p_T $\pi^+ - \pi^-$ Angular Correlations in STAR

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Recently, a new observable was proposed[1] to study chiral symmetry restoration in heavy ion collisions. If chiral symmetry is restored, the time dependence of the relaxation of the chiral order parameter introduces oscillations in the pion feld which can generate soft, charge-conjugate pion pairs, which acts effectively like a pion antenna.

The calculations predict a back-to-back correlation in relative azimuthal angle of oppositely charged pion pairs at midrapidity within 1 unit of rapidity ($|y| \leq 0.5$), which is largest at very low p_T and disappears around p_T = 300 MeV/c. The magnitude of the experimental signal for the lowest measurable p_T range, $100 \leq p_T \leq 150$ MeV/c, is expected to be on the order of 1%.

In order to search for this effect at STAR, 100K central (∼0-10%) events from each of the $\sqrt{s_{NN}}$=130, 200 GeV datasets were analyzed. Pions were identified via dE/dx. The relative azimuthal angle between pion pairs was computed using the dot product of their transverse momentum vectors measured in the TPC. A mixed event background was also generated, using uncorrelated pions from different events.

Figs. 1 and 2 show the correlation (ratio of signal to mixed event) as a function of relative angle at 130 and 200 GeV, respectively for the lowest p_T range, $100 \leq p_T \leq 150$ MeV/c. The peak at low relative angle, on the order of 1-2%, is most probably due to Coulomb correlations. The pion antenna effect, which is expected at $\Delta\phi = 180^\circ$, is not evident in either dataset. The single bin above the background in the 200 GeV data is probably an artifact, since the width of the signal is too narrow; the expected correlation signal has a width of nearly 30°.

It has been suggested that elliptic flow, which is also an azimuthal effect and is on the order of 1% in this p_T range for central collisions, might obscure a pion antenna correlation.

A further analysis of the 200 GeV dataset, using the full central statistics of ∼ 3.5M events, and considering in more detail subtle experimental effects, will be undertaken once the data are available.

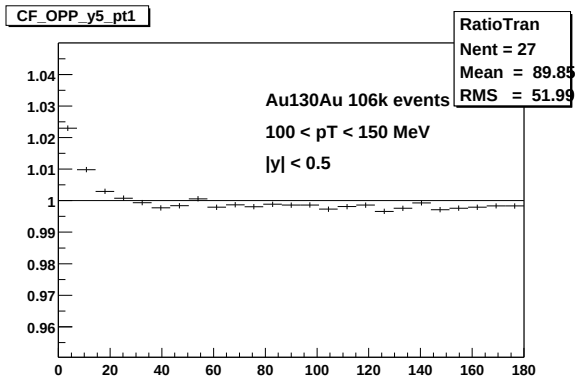

Figure 1: Correlation in relative azimuthal angle, $\Delta\phi$, for $\sqrt{s_{NN}}$=130 GeV Au+Au collisions.

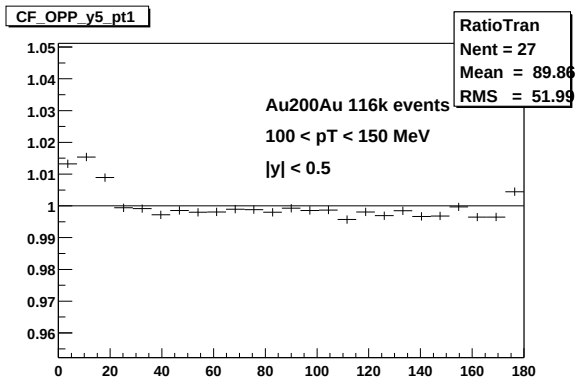

Figure 2: Correlation in relative azimuthal angle, $\Delta\phi$, for $\sqrt{s_{NN}}$=200 GeV Au+Au collisions.

References

[1] J. Randrup, Phys. Rev. C **63**, 061901(R) (2001).